PATENT ABSTRACTS OF JAPAN

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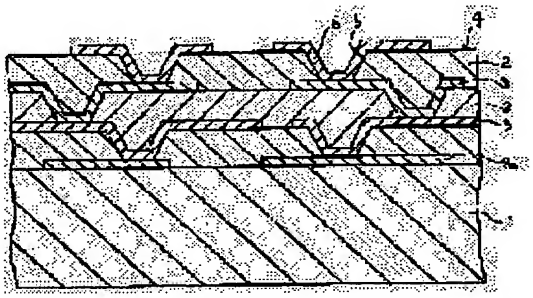
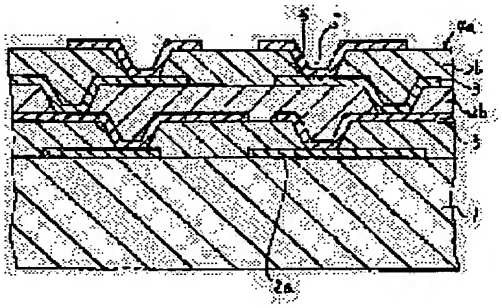
(54) METHOD FOR MANUFACTURING MULTILAYER WIRING BOARD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a multilayer wiring board for achieving desired characteristics fully by increasing adhesion between organic resin insulation layers and preventing peeling from occurring between the organic resin insulation layers owing to the application of outer force.
SOLUTION: In a wiring board, a multilayer wiring part 4 is formed, where an organic resin insulation layer 2 and a thin-film wiring conductor 3 are alternately stack on an insulation substrate 1. In this case, the multilayer wiring part 4 is formed by a following process. An organic resin precursor 2b in semi- cured state and a thin-film wiring conductor 3 are stacked in multilayer alternately on the insulation substrate 1, thus forming a multilayer wiring region 4a. After that, the multilayer wiring region 4a is heat-treated, thus curing each half-cured organic resin precursor completely.





LEGAL STATUS

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CLAIMS

[Claim(s)]
[Claim 1] an insulating-substrate top — an organic resin insulating layer and thin film wiring — the multilayer-interconnection substrate which forms the multilayer-interconnection section which carried out the laminating of the conductor by turns, and changes — it is — said multilayer-interconnection section — the following — the manufacture approach of the multilayer-interconnection substrate characterized by being formed of the process of (1) thru/or (4). The process to which it heat-treats while applying (1) organic resin precursor on an insulating substrate, and semi-hardening of the organic resin precursor is carried out, (2) — the organic resin precursor top face of said semi-hardening — thin film wiring of a predetermined pattern — with the process which forms a conductor (3) The above (1) and the process of (2) are repeated. The organic resin precursor of semi-hardening, thin film wiring of a predetermined pattern — the process which carries out the laminating of the conductor to a multilayer by turns, and forms a multilayer-interconnection field, and (4) — the process which heat-treats said multilayer-interconnection field, is made to harden the organic resin precursor of each semi-hardening completely, and is made with an organic resin insulating layer.
[Claim 2] an insulating-substrate top — an organic resin insulating layer and thin film wiring — the multilayer-interconnection substrate which forms the multilayer-interconnection section which carried out the laminating of the conductor by turns, and changes — it is — said multilayer-interconnection section — the following — the manufacture approach of the multilayer-interconnection substrate characterized by being formed of the process of (1) thru/or (4). The process to which semi-hardening of Mitsuteru putting and the photosensitive organic resin precursor is carried out while applying (1) photosensitivity organic resin precursor on an insulating substrate, (2) — the photosensitive organic resin precursor top face of said

semi-hardening — thin film wiring of a predetermined pattern — with the process which forms a conductor (3) The above (1) and the process of (2) are repeated. The photosensitive organic resin precursor of semi-hardening, thin film wiring of a predetermined pattern — the process which carries out the laminating of the conductor to a multilayer by turns, and forms a multilayer-interconnection field, and (4) — the process which heat-treats said multilayer-interconnection field, is made to harden completely the photosensitive organic resin precursor of each semi-hardening, and is made with an organic resin insulating layer.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the multilayer-interconnection substrate used for the package for semiconductor device receipt which holds hybrid integrated circuit equipment and a semiconductor device in a detail more about a multilayer-interconnection substrate.

[0002]

[Description of the Prior Art] the multilayer-interconnection substrate conventionally used for hybrid integrated circuit equipment, the package for semiconductor device receipt, etc. — the wiring — the conductor is formed by thick-film formation techniques, such as the Mo-Mn method.

[0003] This Mo-Mn method is an approach of calcinating in reducing atmosphere while carrying out addition mixing of an organic solvent and the solvent at refractory metal powder, such as a tungsten, molybdenum, and manganese, usually carrying out printing spreading of the shape of a paste, and the made metal paste with screen printing at the outside surface of a raw ceramic object at a predetermined pattern and then carrying out two or more sheet laminating of this, and carrying out the sintering unification of refractory metal powder and the raw ceramic object.

[0004] in addition, said wiring — as a ceramic object with which a conductor is formed, non-oxide system ceramics which made the oxide film put on oxide system ceramics, such as a nature sintered compact of an aluminum oxide and a nature sintered compact of a mullite, or a front face, such as a nature sintered compact of alumimium nitride and a nature sintered compact of silicon carbide, are usually used.

[0005] however, this Mo-Mn method — using — wiring — the case where a conductor is formed — wiring — detailed-izing since it is formed when a conductor screen-stencils a metal paste — difficult — wiring — it had the fault that a conductor could not be formed in high density.

[0006] in order [then,] to cancel the above-mentioned fault — wiring — the multilayer-interconnection substrate which changed the conductor into forming with the conventional thick-film formation technique, and was formed in high density using the thin film coating technology in which detailed-izing is possible has come to be used.

[0007] this wiring — the multilayer-interconnection substrate which formed the conductor by thin film coating technology The insulating layer which consists of organic resin, such as an epoxy resin formed in the top face of the insulating substrate which consists of the glass epoxy which an epoxy resin is infiltrated into the glass fabric which wove in the ceramic which consists of the nature sintered compact of an aluminum oxide etc., and the glass fiber, and is formed in it of a spin coat method, heat-curing processing, etc., thin film wiring formed in metals, such as copper and aluminum, by adopting thin film coating technology and photolithography techniques, such as the galvanizing method and vacuum deposition, — it has the structure where the laminating of the conductor was carried out to the multilayer by turns.

[0008] It connects electrically through the conductor. moreover, thin film wiring currently arranged in this multilayer-interconnection substrate between each organic resin insulating layer by which the laminating was carried out — the through hole where the conductor is put on the wall of the through hole formed in the organic resin insulating layer if needed — Formation of the through hole to each organic resin insulating layer exposes this while applying resist material on each organic resin insulating layer. By developing negatives, form the window part of a predetermined configuration in a predetermined location, then, arrange an etching reagent on the window part of said resist material, and the organic resin insulating layer located in the window part of resist material is removed. A hole (through hole) is formed in an organic resin insulating layer, and it is carried out by making said resist material exfoliate from an organic resin insulating-layer top, and finally, removing it.

[0009]

[Problem(s) to be Solved by the Invention] however, this conventional multilayer-interconnection substrate — setting — an organic resin insulating layer and thin film wiring — in case the laminating of the conductor is carried out by turns and it makes with a multilayer-interconnection substrate, as for each organic resin

insulating layer, heat curing of that each is completely carried out by heat treatment, and each organic resin insulating layer does not almost have the radical which participates in a polymerization reaction. Therefore, when forming an organic resin insulating layer in a multilayer up and down, the organic resin insulating layer located in the lower part already heat-hardens. The organic resin insulating layer located in the upper part since there is almost no radical which participates in a polymerization reaction becomes what has the weak bonding strength to the organic resin insulating layer located in the lower part. Consequently, if external force is impressed to an organic resin insulating layer, exfoliation will occur between each organic resin insulating layer according to this external force, and the fault of losing the function as a multilayer-interconnection substrate will be induced.

[0010]

[Means for Solving the Problem] that by which this invention was thought out in view of the above-mentioned fault — it is — the purpose — an organic resin insulating layer and thin film wiring — it is the multilayer-interconnection substrate which carries out the laminating of the conductor to a multilayer by turns, and changes, and bonding strength between each of said organic resin insulating layer strengthens, and the property for which it asks by preventing effectively that exfoliation occurs between organic resin insulating layers also by external-force impression is to offer the multilayer-interconnection substrate fully demonstrated.

[0011] this invention — an insulating-substrate top — an organic resin insulating layer and thin film wiring — the multilayer-interconnection substrate which forms the multilayer-interconnection section which carried out the laminating of the conductor by turns, and changes — it is — said multilayer-interconnection section — the following — it is characterized by being formed of the process of (1) thru/or (4).

[0012] The process to which it heat-treats while applying (1) organic resin precursor on an insulating substrate, and semi-hardening of the organic resin precursor is carried out, (2) — the organic resin precursor top face of said semi-hardening — thin film wiring of a predetermined pattern — with the process which forms a conductor (3) The above (1) and the process of (2) are repeated. The organic resin precursor of semi-hardening, thin film wiring of a predetermined pattern — the process which carries out the laminating of the conductor to a multilayer by turns, and forms a multilayer-interconnection field, and (4) — the process which heat-treats said multilayer-interconnection field, is made to harden the organic resin precursor of each semi-hardening completely, and is made with an organic resin insulating layer.

[0013] moreover, this invention — an insulating-substrate top — an organic resin

insulating layer and thin film wiring — the multilayer-interconnection substrate which forms the multilayer-interconnection section which carried out the laminating of the conductor by turns, and changes — it is — said multilayer-interconnection section — the following — it is characterized by being formed of the process of (1) thru/or (4).

[0014] The process to which semi-hardening of Mitsuteru putting and the photosensitive organic resin precursor is carried out while applying (1) photosensitivity organic resin precursor on an insulating substrate, (2) — the photosensitive organic resin precursor top face of said semi-hardening — thin film wiring of a predetermined pattern — with the process which forms a conductor (3) The above (1) and the process of (2) are repeated. The photosensitive organic resin precursor of semi-hardening, thin film wiring of a predetermined pattern — the process which carries out the laminating of the conductor to a multilayer by turns, and forms a multilayer-interconnection field, and (4) — the process which heat-treats said multilayer-interconnection field, is made to harden completely the photosensitive organic resin precursor of each semi-hardening, and is made with an organic resin insulating layer.

[0015] According to the manufacture approach of the multilayer-interconnection substrate of this invention, after carrying out the laminating of the organic resin precursor of a semi-hardening condition to a multilayer up and down, in order to carry out full hardening of all the organic resin precursors at once, the radical to which the organic resin precursor in the semi-hardening condition of being located in the lower part participates in a polymerization reaction fully exists. Therefore, in case heat is applied to each organic resin precursor located up and down and full hardening is carried out at once, each organic resin precursor of generating exfoliation located up and down is lost, even if, as for a lifting, consequently each organic resin insulating layer, the each joins firmly and external force is mutually impressed in a polymerization reaction between the upper and lower sides.

[0016] moreover — according to the manufacture approach of this invention — wiring — since the conductor was formed by thin film coating technology, detailed-ization of wiring is attained, and it becomes possible to form wiring in high density extremely.

[0017]

[Embodiment of the Invention] Next, this invention is explained to a detail based on an accompanying drawing. one example of the multilayer-interconnection substrate by which drawing 1 was manufactured by the manufacture approach of this invention — being shown — 1 — an insulating substrate and 2 — an organic resin insulating layer and 3 — thin film wiring — it is a conductor.

[0018] said insulating substrate 1 — the top face — the organic resin insulating layer 2 and thin film wiring — the multilayer-interconnection section 4 which consists of a conductor 3 is arranged, and it acts as supporter material which supports this multilayer-interconnection section 4.

[0019] The glass epoxy resin which infiltrated the epoxy resin into the cloth with which said insulating substrate 1 wove in the glass fiber, Oxide system ceramics, such as a nature sintered compact of an aluminum oxide, and a nature sintered compact of a mullite, Or it is formed in the front face with electrical insulation materials which have the oxide film, such as non-oxide system ceramics, such as a nature sintered compact of alumimium nitride, and a nature sintered compact of silicon carbide. for example, when formed with the nature sintered compact of an aluminum oxide The suitable organic solvent for raw material powder, such as an alumina, a silica, calcia, and a magnesia, A ceramic green sheet (ceramic student sheet) is formed by adopting a well-known doctor blade method and the well-known calendering roll method for this conventionally, while carrying out addition mixing of the solvent and making with the shape of slurry. By calcinating at an elevated temperature (about 1600 degrees C), while performing suitable punching processing for said ceramic green sheet and making with a predetermined configuration after an appropriate time Or while carrying out addition mixing of the suitable organic solvent for raw material powder, such as an alumina, and the solvent and adjusting raw material powder, this raw material powder is fabricated in a predetermined configuration with a press-forming machine. In being manufactured by finally calcinating said Plastic solid at the temperature of about 1600 degrees C and consisting of a glass epoxy resin While infiltrating the precursor of an epoxy resin into the cloth which wove in the glass fiber, it is manufactured by carrying out heat curing of this epoxy resin precursor at predetermined temperature.

[0020] said insulating substrate 1 — again — the top face — the organic resin insulating layer 2 and thin film wiring — thin film wiring with which the organic resin insulating layer 2 which the multilayer-interconnection section 4 by which the conductor 3 was arranged by turns in the multilayer is put, and constitutes this multilayer-interconnection section 4 is located up and down — while succeeding in the operation which aims at an electric insulation of a conductor 3 — thin film wiring — a conductor 3 acts as a transfer way for transmitting an electrical signal.

[0021] in addition, the organic resin insulating layer 2 of said multilayer-interconnection section 4 — from resin, such as an epoxy resin, polyimide resin, bismaleimide triazine resin, polyphenylene ether resin, and a fluororesin, — changing — moreover, thin film wiring — the conductor 3 is formed with metallic

materials, such as copper.

[0022] moreover, thin film wiring with which the through hole 5 is formed if needed, and the organic resin insulating layer 2 of said multilayer-interconnection section 4 is located in the wall of this through hole 5 up and down on both sides of the organic resin insulating layer 2 in between — the through hole which connects a conductor 3 electrically — the conductor 6 is formed.

[0023] thin film wiring with which the through hole 5 formed in said organic resin insulating layer 2 is about about 1.5 times to the thickness of the organic resin insulating layer 2, and, as for this through hole 5, the path is located up and down through the organic resin insulating layer 2 — the through hole which connects each of a conductor 3 electrically — it acts as a formation hole for forming a conductor 6.

[0024] furthermore, the through hole put on the wall of the through hole 5 formed in the organic resin insulating layer 2 — each thin film wiring with which a conductor 6 is located up and down on both sides of the organic resin insulating layer 2 — it succeeds in the operation which connects each of a conductor 3 electrically.

[0025] in addition, said organic resin insulating layer 2 and thin film wiring — if the multilayer interconnection 4 formed by carrying out the laminating of the conductor 3 to a multilayer by turns makes the top face of each organic resin insulating layer 2 the 0.05 micrometer<=Ra <=5micrometer split face by the center line average of roughness height (Ra) — the organic resin insulating layer 2 and thin film wiring — the junction to a conductor 3 and organic resin insulating-layer 2 comrades located up and down are joinable in it being firm. Therefore, as for each organic resin insulating layer 2 of said multilayer interconnection 4, what the top face is made into the 0.05 micrometer<=Ra <=5micrometer split face for by rough ** and the center line average of roughness height (Ra) by the etching processing method etc. is desirable.

[0026] Moreover, if the thickness exceeds 100 micrometers in each, when said organic resin insulating layer 2 will form a through hole 5 in the organic resin insulating layer 2, It becomes difficult to form in the clear configuration which asks for a through hole 5. moreover, thin film wiring which an unnecessary hole is formed in the organic resin insulating layer 2, and is located in it up and down when split-face processing for raising the bonding strength of the organic resin insulating layer 2 which is located in the top face of the organic resin insulating layer 2 up and down when it comes to under 5 micrometerm is performed — there is a danger of inviting an unnecessary electric short circuit to a conductor 3. Therefore, as for said organic resin insulating layer 2, what the thickness is made into the range of 5 micrometers thru/or 100 micrometers for in each is desirable.

[0027] It will become difficult to make a predetermined electrical signal transmit to a conductor 3. furthermore, each thin film wiring of said multilayer interconnection 4 -- if, as for a conductor 3, the thickness is set to less than 1 micrometer — each thin film wiring — what has the big electric resistance of a conductor 3 — becoming — each thin film wiring — moreover — if 40 micrometers is exceeded — thin film wiring — the time of making a conductor 3 put on the organic resin insulating layer 2 — thin film wiring — the big stress inside a conductor 3 — inherent — this size — **** immanency stress — thin film wiring — a conductor 3 tends to exfoliate from the organic resin insulating layer 2. therefore, each thin film wiring of said multilayer interconnection 4 — as for the thickness of a conductor 3, what is considered as the range of 1 micrometer thru/or 40 micrometers is desirable.

[0028] Next, the manufacture approach of an above-mentioned multilayer-interconnection substrate is explained to a detail based on drawing 2 thru/or drawing 5 . it is first shown in drawing 2 — as — a top face — wiring — a conductor — the insulating substrate 1 which has 2a is prepared. The glass epoxy resin which infiltrated the epoxy resin into the cloth with which said insulating substrate 1 wove in the glass fiber, Oxide system ceramics, such as a nature sintered compact of an aluminum oxide, and a nature sintered compact of a mullite, Or it is formed in the front face with electrical insulation materials which have the oxide film, such as non-oxide system ceramics, such as a nature sintered compact of alumimium nitride, and a nature sintered compact of silicon carbide. wiring — a conductor — 2a by processing into a predetermined pattern the copper plate made to put on an insulating substrate 1 by the etching processing method Or while carrying out printing spreading of the metal paste with screen printing on an insulating substrate 1 at a predetermined pattern, it is formed by the ability burning this at predetermined temperature.

[0029] Next, as shown in drawing 3 , covering formation of the organic resin precursor 2b of the semi-hardening which has a through hole 5 on the top face of an insulating substrate 1 is carried out.

[0030] Said organic resin precursor 2b which carried out semi-hardening An epoxy resin, polyimide resin, In consisting of resin photosensitive [, such as bismaleimide triazine resin, polyphenylene ether resin and a fluororesin,] or thermosetting, for example, consisting of a thermosetting epoxy resin To the bisphenol A mold epoxy resin, a novolak mold epoxy resin, a glycidyl ester mold epoxy resin, etc., an amine system curing agent, While carrying out addition mixing of the curing agents, such as an imidazole system curing agent and an acid-anhydride system curing agent, and

obtaining a paste-like epoxy resin precursor, this epoxy resin precursor is made to apply with a spin coat method etc. on an insulating substrate 1. In being formed by heat-treating this for 0.5 to 2 hours, and carrying out semi-hardening with 80 degrees C - 200 degrees C heat after an appropriate time and consisting of a photosensitive epoxy resin Phenol novolak resin, a methylol melamine, While carrying out addition mixing of the propylene-glycol-monomethyl-ether acetate at diaryl diazonium salt and obtaining a photosensitive paste-like epoxy resin precursor, predetermined thickness is made to put this with a spin coat method, a doctor blade method, etc. on an insulating substrate 1. After an appropriate time, It is 1 - 3 J/cm3 to a photosensitive epoxy resin precursor with the exposure machine which used the high-pressure mercury lamp etc. for this. Energy is irradiated and it is formed by carrying out semi-hardening of the photosensitive epoxy resin precursor.

[0031] moreover, when organic resin precursor 2b of a semi-hardening condition consists of a thermosetting epoxy resin, the through hole 5 currently formed in organic resin precursor 2b of said semi-hardening condition In consisting of a photosensitive epoxy resin again by irradiating an YAG laser, an excimer laser, etc. and making a hole in organic resin precursor 2b of semi-hardening A photosensitive paste-like epoxy resin precursor is applied to predetermined thickness on an insulating substrate 1. In case this is exposed with the exposure machine using a high-pressure mercury lamp etc. and it considers as a semi-hardening condition after an appropriate time The mask of a predetermined configuration is arranged on the front face of the photosensitive epoxy resin precursor beforehand applied on the insulating substrate 1, and the exposure to a photosensitive epoxy resin precursor is interrupted with this mask, and while preventing considering as a semi-hardening condition, it is formed by removing by development.

[0032] and it is shown in drawing 4 below — as — the top face of said organic resin precursor 2b which carried out semi-hardening — thin film wiring of a predetermined pattern — a conductor 3 is formed.

[0033] A conductor 3 consists of metallic materials, such as copper, nickel, gold, and aluminum. said thin film wiring — It is formed by adopting thin film coating technology and photolithography techniques, such as a nonelectrolytic plating method, and vacuum deposition, the sputtering method. for example, in forming by adopting a copper nonelectrolytic plating method On the organic resin precursor 2b top face of semi-hardening, a 0.06 mols [/l.] copper sulfate, Formalin 0.3mol/l., a 0.35 mols [/l.] sodium hydroxide, 1 micrometer in thickness and a 40-micrometer copper layer are made to put using the nonelectrolytic plating bath which consists of 0.35 mols [/l.]

ethylenediaminetetraacetic acid. It is formed in the organic resin precursor 2b top face of a semi-hardening condition by processing said copper layer into a predetermined pattern with a photolithography technique after an appropriate time. in this case, thin film wiring — detailed-izing of wiring since a conductor 3 is formed of thin film coating technology — possible — this — thin film wiring — it becomes possible to form a conductor 3 in high density extremely.

[0034] and a degree — formation of organic resin precursor 2b of said semi-hardening condition, and thin film wiring — it carries out by repeating formation of a conductor 3, and is shown in drawing 5 — as — an insulating-substrate 1 top — the layer of organic resin precursor 2b of a semi-hardening condition, and thin film wiring — multilayer-interconnection field 4a which carried out the laminating of the layer of a conductor 3 to the multilayer by turns is formed.

[0035] in addition, thin film wiring located up and down on both sides of the layer of organic resin precursor 2b of a semi-hardening condition in between at this time — thin film wiring located in the wall of the through hole 5 established in the layer of organic resin precursor 2b of a semi-hardening condition when a conductor 3 needed to be connected electrically up and down — the through hole which connects a conductor 3 electrically — what is necessary is just to make a conductor 6 put

[0036] and the last — said insulating-substrate 1 top — the layer of organic resin precursor 2b of a semi-hardening condition, and thin film wiring — multilayer-interconnection field 4a which carried out the laminating of the layer of a conductor 3 to the multilayer by turns at the temperature of 130 degrees C - 230 degrees C for 0.5 to 3 hours It heat-treats, heat curing of all the organic resin precursor 2bs of each semi-hardening condition is carried out that it is simultaneous and completely, and the multilayer-interconnection substrate as a product shown in drawing 1 is completed by making with the organic resin insulating layer 2. In this case Each organic resin precursor 2b located up and down if organic resin precursor 2b of each semi-hardening condition applies heat to each organic resin precursor 2b located up and down and it is made it to carry out full hardening at once, since the radical which participates in a polymerization reaction fully exists in the interior is set between the upper and lower sides. Mutually a polymerization reaction A lifting, Consequently, generating exfoliation is lost, even if the each joins each organic resin insulating layer 2 firmly and external force is impressed.

[0037] If this invention is range which is not limited to an above-mentioned example and does not deviate from the summary of this invention, in addition, various modification in the above-mentioned example possible wiring to which the copper

plate was processed into the predetermined pattern for the top face — a conductor — the insulating–substrate 1 top which has 2a — the organic resin insulating layer 2 and thin film wiring, although the laminating of the conductor 3 was carried out to the multilayer by turns an insulating–substrate 1 top — thin film coating technology and photolithography techniques, such as a direct and nonelectrolytic plating method, — thin film wiring — a conductor 3 is formed, after an appropriate time, the laminating of the organic resin insulating layer 2 may be carried out to a multilayer, and it may be formed in the upper part.

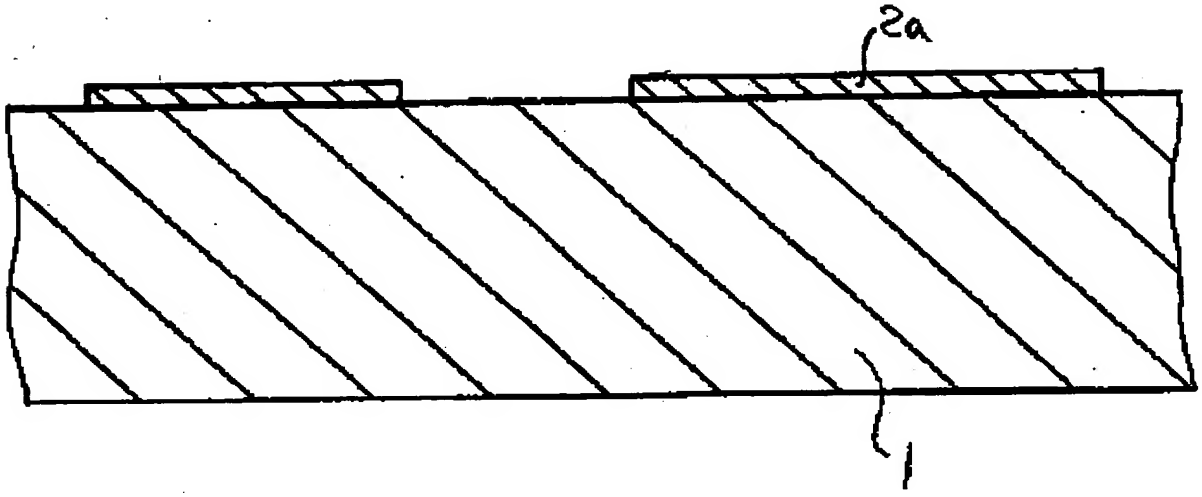
[0038]

[Effect of the Invention] According to the manufacture approach of the multilayer–interconnection substrate of this invention, after carrying out the laminating of the organic resin precursor of a semi–hardening condition to a multilayer up and down, in order to carry out full hardening of all the organic resin precursors at once, the radical to which the organic resin precursor in the semi–hardening condition of being located in the lower part participates in a polymerization reaction fully exists. Therefore, in case heat is applied to each organic resin precursor located up and down and full hardening is carried out at once, each organic resin precursor of generating exfoliation located up and down is lost, even if, as for a lifting, consequently each organic resin insulating layer, the each joins firmly and external force is mutually impressed in a polymerization reaction between the upper and lower sides.

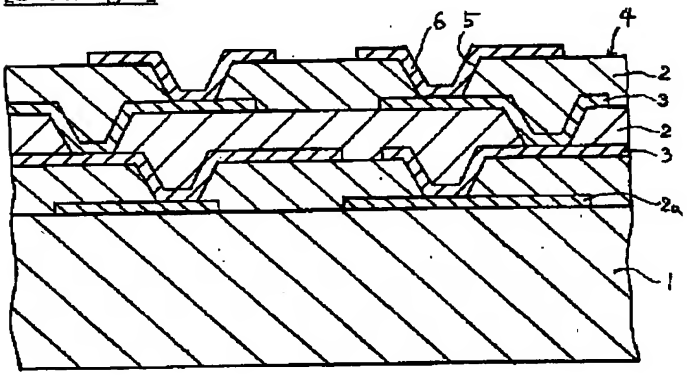
[0039] moreover — according to the manufacture approach of this invention — wiring — since the conductor was formed by thin film coating technology, detailed–ization of wiring is attained, and it becomes possible to form wiring in high density extremely.

DRAWINGS

[Drawing 2]



[Drawing 1]



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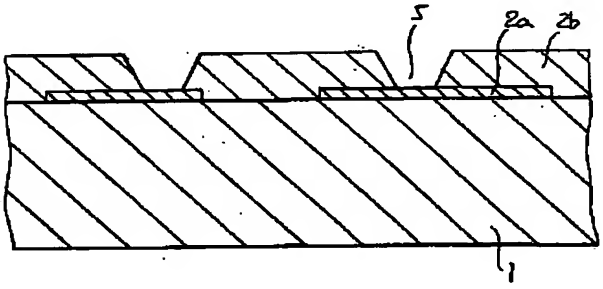
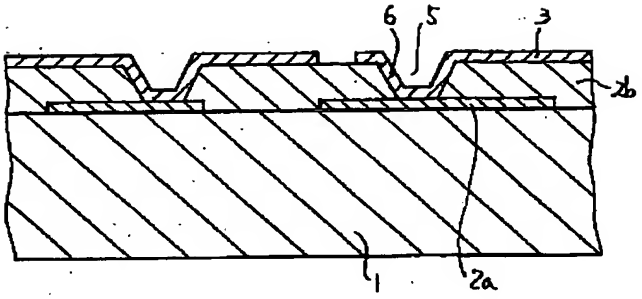


[Drawing 4]



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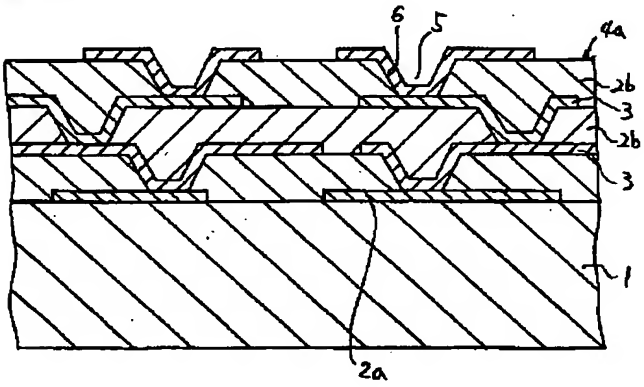

[Translation done.]

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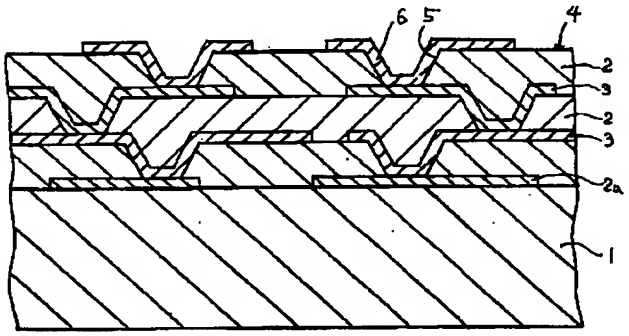
(54)【発明の名称】　多層配線基板の製造方法

(57)【要約】
【課題】有機樹脂絶縁層間に外力印加によって剥離が発生する。
【解決手段】絶縁基板１上に有機樹脂絶縁層２と薄膜配線導体３とを交互に積層した多層配線部４を形成して成る多層配線基板であって、前記多層配線部４が下記の工程により形成される。絶縁基板１上に半硬化状態の有機樹脂前駆体２ｂと薄膜配線導体３とを交互に多層に積層して多層配線領域４ａを形成し、しかる後、前記多層配線領域４ａを熱処理し、各半硬化の有機樹脂前駆体を完全に硬化させる。



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【特許請求の範囲】

【請求項１】絶縁基板上に有機樹脂絶縁層と薄膜配線導体とを交互に積層した多層配線部を形成して成る多層配線基板であって、前記多層配線部が下記（１）乃至（４）の工程により形成されることを特徴とする多層配線基板の製造方法。絶縁基板上に、（１）有機樹脂前駆体を塗布するとともに熱処理し、有機樹脂前駆体を半硬化させる工程と、（２）前記半硬化の有機樹脂前駆体上面に所定パターンの薄膜配線導体を形成する工程と、（３）前記（１）及び（２）の工程を繰り返し、半硬化の有機樹脂前駆体と、所定パターンの薄膜配線導体とを交互に多層に積層し、多層配線領域を形成する工程と、（４）前記多層配線領域を熱処理し、各半硬化の有機樹脂前駆体を完全に硬化させ、有機樹脂絶縁層となす工程。

【請求項２】絶縁基板上に有機樹脂絶縁層と薄膜配線導体とを交互に積層した多層配線部を形成して成る多層配線基板であって、前記多層配線部が下記（１）乃至（４）の工程により形成されることを特徴とする多層配線基板の製造方法。絶縁基板上に、（１）感光性有機樹脂前駆体を塗布するとともに光照射し、感光性有機樹脂前駆体を半硬化させる工程と、（２）前記半硬化の感光性有機樹脂前駆体上面に所定パターンの薄膜配線導体を形成する工程と、（３）前記（１）及び（２）の工程を繰り返し、半硬化の感光性有機樹脂前駆体と、所定パターンの薄膜配線導体とを交互に多層に積層し、多層配線領域を形成する工程と、（４）前記多層配線領域を熱処理し、各半硬化の感光性有機樹脂前駆体を完全に硬化させ、有機樹脂絶縁層となす工程。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、多層配線基板に関し、より詳細には混成集積回路装置や半導体素子を収容する半導体素子収納用パッケージ等に使用される多層配線基板に関するものである。

【０００２】

【従来の技術】従来、混成集積回路装置や半導体素子収納用パッケージ等に使用される多層配線基板はその配線導体がＭｏ－Ｍｎ法等の厚膜形成技術によって形成されている。

【０００３】このＭｏ－Ｍｎ法は通常、タングステン、モリブデン、マンガン等の高融点金属粉末に有機溶剤、溶媒を添加混合し、ペースト状となした金属ペーストを生セラミック体の外表面にスクリーン印刷法により所定パターンに印刷塗布し、次ぎにこれを複数枚積層するとともに還元雰囲気中で焼成し、高融点金属粉末と生セラミック体とを焼結一体化させる方法である。

【０００４】尚、前記配線導体が形成されるセラミック体としては通常、酸化アルミニウム質焼結体やムライト質焼結体等の酸化物系セラミックス、或いは表面に酸化

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物膜を被着させた窒化アルミニウム質焼結体や炭化珪素質焼結体等の非酸化物系セラミックが使用される。

【０００５】しかしながら、このＭｏ－Ｍｎ法を用いて配線導体を形成した場合、配線導体は金属ペーストをスクリーン印刷することにより形成されることから微細化が困難で配線導体を高密度に形成することができないという欠点を有していた。

【０００６】そこで上記欠点を解消するために配線導体を従来の厚膜形成技術で形成するのに変えて微細化が可能な薄膜形成技術を用いて高密度に形成した多層配線基板が使用されるようになってきた。

【０００７】かかる配線導体を薄膜形成技術により形成した多層配線基板は、酸化アルミニウム質焼結体等から成るセラミックやガラス繊維を織り込んだガラス布にエポキシ樹脂を含浸させて形成されるガラスエポキシ等から成る絶縁基板の上面にスピンコート法及び熱硬化処理等によって形成されるエポキシ樹脂等の有機樹脂から成る絶縁層と、銅やアルミニウム等の金属をめっき法や蒸着法等の薄膜形成技術及びフォトリソグラフィー技術を採用することによって形成される薄膜配線導体とを交互に多層に積層させた構造を有している。

【０００８】またこの多層配線基板においては、積層された各有機樹脂絶縁層間に配設されている薄膜配線導体が必要に応じて有機樹脂絶縁層に形成したスルーホールの内壁に被着されているスルーホール導体を介して電気的に接続されており、各有機樹脂絶縁層へのスルーホールの形成は各有機樹脂絶縁層上にレジスト材を塗布するとともにこれを露光、現像を施すことによって所定位置に所定形状の窓部を形成し、次に前記レジスト材の窓部にエッチング液を配し、レジスト材の窓部に位置する有機樹脂絶縁層を除去して、有機樹脂絶縁層に穴（スルーホール）を形成し、最後に前記レジスト材を有機樹脂絶縁層上より剥離させ除去することによって行われている。

【０００９】

【発明が解決しようとする課題】しかしながら、この従来の多層配線基板においては、有機樹脂絶縁層と薄膜配線導体とを交互に積層して多層配線基板となす際、各有機樹脂絶縁層はその各々が熱処理によって完全に熱硬化されており、各有機樹脂絶縁層は重合反応に関与する基が殆どない。そのため有機樹脂絶縁層を上下に多層に形成する場合、下部に位置する有機樹脂絶縁層は既に熱硬化し、重合反応に関与する基が殆どないことから上部に位置する有機樹脂絶縁層は下部に位置する有機樹脂絶縁層に対する接合強度が弱いものとなり、その結果、有機樹脂絶縁層に外力が印加されると該外力によって各有機樹脂絶縁層間に剥離が発生し、多層配線基板としての機能を喪失するという欠点を誘発する。

【００１０】

【課題を解決するための手段】本発明は上記欠点に鑑み

案出されたもので、その目的は有機樹脂絶縁層と薄膜配線導体とを交互に多層に積層して成る多層配線基板であって、前記各有機樹脂絶縁層間の接合強度を強くし、外力印加によっても有機樹脂絶縁層間に剥離が発生するのを有効に防止することによって所望する特性が充分に発揮される多層配線基板を提供することにある。

【００１１】本発明は、絶縁基板上に有機樹脂絶縁層と薄膜配線導体とを交互に積層した多層配線部を形成して成る多層配線基板であって、前記多層配線部が下記（１）乃至（４）の工程により形成されることを特徴とするものである。

【００１２】絶縁基板上に、（１）有機樹脂前駆体を塗布するとともに熱処理し、有機樹脂前駆体を半硬化させる工程と、（２）前記半硬化の有機樹脂前駆体上面に所定パターンの薄膜配線導体を形成する工程と、（３）前記（１）及び（２）の工程を繰り返し、半硬化の有機樹脂前駆体と、所定パターンの薄膜配線導体とを交互に多層に積層し、多層配線領域を形成する工程と、（４）前記多層配線領域を熱処理し、各半硬化の有機樹脂前駆体を完全に硬化させ、有機樹脂絶縁層となす工程。

【００１３】また本発明は、絶縁基板上に有機樹脂絶縁層と薄膜配線導体とを交互に積層した多層配線部を形成して成る多層配線基板であって、前記多層配線部が下記（１）乃至（４）の工程により形成されることを特徴とするものである。

【００１４】絶縁基板上に、（１）感光性有機樹脂前駆体を塗布するとともに光照射し、感光性有機樹脂前駆体を半硬化させる工程と、（２）前記半硬化の感光性有機樹脂前駆体上面に所定パターンの薄膜配線導体を形成する工程と、（３）前記（１）及び（２）の工程を繰り返し、半硬化の感光性有機樹脂前駆体と、所定パターンの薄膜配線導体とを交互に多層に積層し、多層配線領域を形成する工程と、（４）前記多層配線領域を熱処理し、各半硬化の感光性有機樹脂前駆体を完全に硬化させ、有機樹脂絶縁層となす工程。

【００１５】本発明の多層配線基板の製造方法によれば、半硬化状態の有機樹脂前駆体を上下に多層に積層した後、全ての有機樹脂前駆体を一度に完全硬化されるため下部に位置する半硬化状態の有機樹脂前駆体は重合反応に関与する基が充分に存在している。そのため上下に位置する各有機樹脂前駆体に熱を加えて一度に完全硬化させる際、上下に位置する各有機樹脂前駆体はその上下間において互いに重合反応を起こし、その結果、各有機樹脂絶縁層はその各々が強固に接合し、外力が印加されても剥離を発生することはなくなる。

【００１６】また本発明の製造方法によれば、配線導体を薄膜形成技術により形成したことから配線の微細化が可能となり、配線を極めて高密度に形成することが可能となる。

【００１７】【発明の実施の形態】次に、本発明を添付図面に基づき詳細に説明する。図１は、本発明の製造方法によって製作された多層配線基板の一実施例を示し、１は絶縁基板、２は有機樹脂絶縁層、３は薄膜配線導体である。

【００１８】前記絶縁基板１はその上面に有機樹脂絶縁層２と薄膜配線導体３とから成る多層配線部４が配設されており、該多層配線部４を支持する支持部材として作用する。

【００１９】前記絶縁基板１はガラス繊維を織り込んだ布にエポキシ樹脂を含浸させたガラスエポキシ樹脂や、酸化アルミニウム質焼結体、ムライト質焼結体等の酸化物系セラミックス、或いは表面に酸化物膜を有する窒化アルミニウム質焼結体、炭化珪素質焼結体等の非酸化物系セラミックス等の電気絶縁材料で形成されており、例えば、酸化アルミニウム質焼結体で形成されている場合には、アルミナ、シリカ、カルシア、マグネシア等の原料粉末に適当な有機溶剤、溶媒を添加混合して泥漿状となすとともにこれを従来周知のドクターブレード法やカレンダーロール法を採用することによってセラミックグリーンシート（セラミック生シート）を形成し、しかる後、前記セラミックグリーンシートに適当な打ち抜き加工を施し、所定形状となすとともに高温（約１６００℃）で焼成することによって、或いはアルミナ等の原料粉末に適当な有機溶剤、溶媒を添加混合して原料粉末を調整するとともに該原料粉末をプレス成形機によって所定形状に成形し、最後に前記成形体を約１６００℃の温度で焼成することによって製作され、またガラスエポキシ樹脂から成る場合には、ガラス繊維を織り込んだ布にエポキシ樹脂の前駆体を含浸させるとともに該エポキシ樹脂前駆体を所定の温度で熱硬化させることによって製作される。

【００２０】前記絶縁基板１はまたその上面に有機樹脂絶縁層２と薄膜配線導体３とが交互に多層に配設された多層配線部４が被着されており、該多層配線部４を構成する有機樹脂絶縁層２は上下に位置する薄膜配線導体３の電気的絶縁を図る作用を為すとともに薄膜配線導体３は電気信号を伝達するための伝達路として作用する。

【００２１】尚、前記多層配線部４の有機樹脂絶縁層２は、エポキシ樹脂、ポリイミド樹脂、ビスマレイミドトリアジン樹脂、ポリフェニレンエーテル樹脂、ふっ素樹脂等の樹脂から成り、また薄膜配線導体３は銅等の金属材料により形成されている。

【００２２】また前記多層配線部４の有機樹脂絶縁層２は必要に応じてスルーホール５が形成されており、該スルーホール５の内壁には上下に有機樹脂絶縁層２を間に挟んで上下に位置する薄膜配線導体３を電気的に接続するスルーホール導体６が形成されている。

【００２３】前記有機樹脂絶縁層２に形成されるスルーホール５はその径が有機樹脂絶縁層２の厚みに対して約１．５倍程度であり、該スルーホール５は有機樹脂絶縁

層２を介して上下に位置する薄膜配線導体３の各々を電気的に接続するスルーホール導体６を形成するための形成孔として作用する。

【００２４】更に有機樹脂絶縁層２に形成されたスルーホール５の内壁に被着されるスルーホール導体６は有機樹脂絶縁層２を挟んで上下に位置する各薄膜配線導体３の各々を電気的に接続する作用を為す。

【００２５】尚、前記有機樹脂絶縁層２と薄膜配線導体３とを交互に多層に積層して形成される多層配線４は各有機樹脂絶縁層２の上面を中心線平均粗さ（Ｒａ）で０．０５μｍ≦Ｒａ≦５μｍの粗面としておくと有機樹脂絶縁層２と薄膜配線導体３との接合及び上下に位置する有機樹脂絶縁層２同士の接合を強固となすことができる。従って、前記多層配線４の各有機樹脂絶縁層２はその上面をエッチング加工法等によって粗し、中心線平均粗さ（Ｒａ）で０．０５μｍ≦Ｒａ≦５μｍの粗面としておくことが好ましい。

【００２６】また前記有機樹脂絶縁層２はその各々の厚みが１００μｍを越えると有機樹脂絶縁層２にスルーホール５を形成する際、スルーホール５を所望する鮮明な形状に形成するのが困難となり、また５μｍｍ未満となると有機樹脂絶縁層２の上面に上下に位置する有機樹脂絶縁層２の接合強度を上げるための粗面加工を施した場合に有機樹脂絶縁層２に不要な穴が形成され上下に位置する薄膜配線導体３に不要な電気的短絡を招来してしまう危険性がある。従って、前記有機樹脂絶縁層２はその各々の厚みを５μｍ乃至１００μｍの範囲としておくことが好ましい。

【００２７】更に前記多層配線４の各薄膜配線導体３はその厚みが１μｍ未満となると各薄膜配線導体３の電気抵抗が大きなものとなって各薄膜配線導体３に所定の電気信号を伝達させることが困難なものとなり、また４０μｍを越えると薄膜配線導体３を有機樹脂絶縁層２に被着させる際に薄膜配線導体３の内部に大きな応力が内在し、該大きな内在応力によって薄膜配線導体３が有機樹脂絶縁層２から剥離し易いものとなる。従って、前記多層配線４の各薄膜配線導体３の厚みは１μｍ乃至４０μｍの範囲としておくことが好ましい。

【００２８】次に上述の多層配線基板の製造方法について図２乃至図５に基づき詳細に説明する。まず図２に示す如く、上面に配線導体２ａを有する絶縁基板１を準備する。前記絶縁基板１はガラス繊維を織り込んだ布にエポキシ樹脂を含浸させたガラスエポキシ樹脂や、酸化アルミニウム質焼結体、ムライト質焼結体等の酸化物系セラミックス、或いは表面に酸化物膜を有する窒化アルミニウム質焼結体、炭化珪素質焼結体等の非酸化物系セラミックス等の電気絶縁材料で形成されており、配線導体２ａは絶縁基板１に被着させた銅板をエッチング加工法により所定パターンに加工することによって、或いは金属ペーストを絶縁基板１上にスクリーン印刷法により所定パターンに印刷塗布するとともにこれを所定の温度で焼き付けることによって形成されている。

【００２９】次に図３に示すように、絶縁基板１の上面にスルーホール５を有する半硬化の有機樹脂前駆体２ｂを被着形成する。

【００３０】前記半硬化した有機樹脂前駆体２ｂはエポキシ樹脂、ポリイミド樹脂、ビスマレイミドトリアジン樹脂、ポリフェニレンエーテル樹脂、ふっ素樹脂等の感光性、或いは熱硬化性の樹脂から成り、例えば熱硬化性のエポキシ樹脂から成る場合には、ビスフェノールＡ型エポキシ樹脂、ノボラック型エポキシ樹脂、グリシジルエステル型エポキシ樹脂等にアミン系硬化剤、イミダゾール系硬化剤、酸無水物系硬化剤等の硬化剤を添加混合してペースト状のエポキシ樹脂前駆体を得るとともに該エポキシ樹脂前駆体を絶縁基板１上にスピンコート法等により塗布させ、しかる後、これを８０℃～２００℃の熱で０．５～２時間熱処理し、半硬化させることによって形成され、また感光性のエポキシ樹脂からなる場合には、フェノールノボラック樹脂、メチロールメラミン、ジアリルジアゾニウム塩にプロピレングリコールモノメチルエーテルアセテートを添加混合してペースト状の感光性エポキシ樹脂前駆体を得るとともにこれを絶縁基板１上にスピンコート法やドクターブレード法等により所定厚みに被着させ、しかる後、これに高圧水銀ランプ等を用いた露光機で感光性エポキシ樹脂前駆体に１～３Ｊ／cm^3のエネルギーを照射し、感光性エポキシ樹脂前駆体を半硬化させることによって形成される。

【００３１】また前記半硬化状態の有機樹脂前駆体２ｂに形成されているスルーホール５は半硬化状態の有機樹脂前駆体２ｂが熱硬化性エポキシ樹脂から成る場合には、半硬化の有機樹脂前駆体２ｂにＹＡＧレーザー、エキシマレーザー等を照射し穴をあけることによって、また感光性エポキシ樹脂から成る場合には、絶縁基板１上にペースト状の感光性エポキシ樹脂前駆体を所定厚みに塗布し、しかる後、これを高圧水銀ランプ等を用いた露光機で露光し、半硬化状態とする際に、予め絶縁基板１上に塗布された感光性エポキシ樹脂前駆体の表面に所定形状のマスクを配置させておき、該マスクで感光性エポキシ樹脂前駆体への露光を遮り、半硬化状態とするのを阻止するとともに現像により除去することによって形成される。

【００３２】そして次に図４に示す如く、前記半硬化した有機樹脂前駆体２ｂの上面に所定パターンの薄膜配線導体３を形成する。

【００３３】前記薄膜配線導体３は銅、ニッケル、金、アルミニウム等の金属材料から成り、無電解めっき法や蒸着法、スパッタリング法等の薄膜形成技術及びフォトリソグラフィ技術を採用することによって形成され、例えば、銅の無電解めっき法を採用することによって形成する場合には、半硬化の有機樹脂前駆体２ｂ上面に硫酸

銅０．０６モル／リットル、ホルマリン０．３モル／リットル、水酸化ナトリウム０．３５モル／リットル、エチレンジアミン四酢酸０．３５モル／リットルから成る無電解めっき浴を用いて厚さ１μｍ乃至４０μｍの銅層を被着させ、しかる後、前記銅層をフォトリソグラフィ技術により所定パターンに加工することによって半硬化状態の有機樹脂前駆体２ｂ上面に形成される。この場合、薄膜配線導体３は薄膜形成技術により形成されることから配線の微細化が可能であり、これによって薄膜配線導体３を極めて高密度に形成することが可能となる。

【００３４】そして次に前記半硬化状態の有機樹脂前駆体２ｂの形成及び薄膜配線導体３の形成を繰り返して行い、図５に示す如く、絶縁基板１上に半硬化状態の有機樹脂前駆体２ｂの層と薄膜配線導体３の層を交互に多層に積層した多層配線領域４ａを形成する。

【００３５】尚、この時、間に半硬化状態の有機樹脂前駆体２ｂの層を挟んで上下に位置する薄膜配線導体３を電気的に接続する必要がある場合には半硬化状態の有機樹脂前駆体２ｂの層に設けたスルーホール５の内壁に上下に位置する薄膜配線導体３を電気的に接続するスルーホール導体６を被着させればよい。

【００３６】そして最後に前記絶縁基板１上に半硬化状態の有機樹脂前駆体２ｂの層と薄膜配線導体３の層とを交互に多層に積層した多層配線領域４ａを１３０℃～２３０℃の温度で０．５～３時間、熱処理し、各半硬化状態の有機樹脂前駆体２ｂの全てを同時に、かつ完全に熱硬化させ、有機樹脂絶縁層２となすことによって図１に示す製品としての多層配線基板が完成する。この場合、各半硬化状態の有機樹脂前駆体２ｂはその内部に重合反応に関与する基が充分に存在しているため上下に位置する各有機樹脂前駆体２ｂに熱を加えて一度に完全硬化させると上下に位置する各有機樹脂前駆体２ｂはその上下間において互いに重合反応を起こし、その結果、各有機樹脂絶縁層２はその各々が強固に接合し、外力が印加されても剥離を発生することはなくなる。

【００３７】尚、本発明は上述の実施例に限定されるものではなく、本発明の要旨を逸脱しない範囲であれば種々の変更は可能であり、例えば上述の実施例では、上面に銅板を所定パターンに加工した配線導体２ａを有する絶縁基板１上に有機樹脂絶縁層２と薄膜配線導体３とを＊交互に多層に積層したが、絶縁基板１上に直接、無電解めっき法等の薄膜形成技術及びフォトリソグラフィ技術により薄膜配線導体３を形成し、しかる後、その上部に有機樹脂絶縁層２を多層に積層して形成してもよい。

【００３８】

【発明の効果】本発明の多層配線基板の製造方法によれば、半硬化状態の有機樹脂前駆体を上下に多層に積層した後、全ての有機樹脂前駆体を一度に完全硬化されるため下部に位置する半硬化状態の有機樹脂前駆体は重合反応に関与する基が充分に存在している。そのため上下に位置する各有機樹脂前駆体に熱を加えて一度に完全硬化させる際、上下に位置する各有機樹脂前駆体はその上下間において互いに重合反応を起こし、その結果、各有機樹脂絶縁層はその各々が強固に接合し、外力が印加されても剥離を発生することはなくなる。

【００３９】また本発明の製造方法によれば、配線導体を薄膜形成技術により形成したことから配線の微細化が可能となり、配線を極めて高密度に形成することが可能となる。

【図面の簡単な説明】

【図１】本発明の製造方法によって製作された多層配線基板の一実施例を示す断面図である。

【図２】本発明の多層配線基板の製造方法を説明するための断面図である。

【図３】本発明の多層配線基板の製造方法を説明するための断面図である。

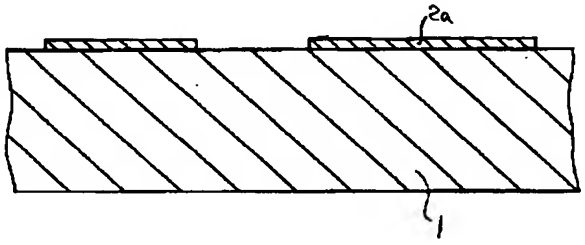
【図４】本発明の多層配線基板の製造方法を説明するための断面図である。

【図５】本発明の多層配線基板の製造方法を説明するための断面図である。

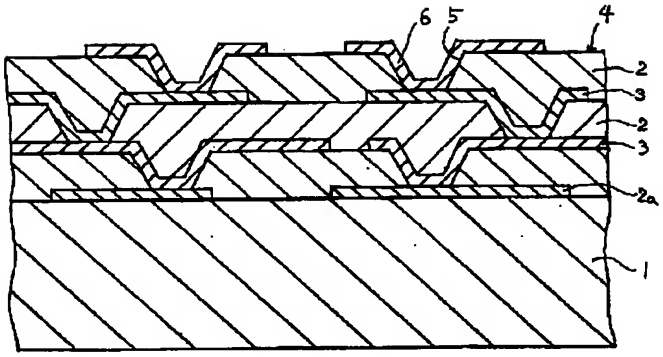
【符号の説明】

１・・・絶縁基板
２・・・有機樹脂絶縁層
２ｂ・・有機樹脂前駆体
３・・・薄膜配線導体
４・・・多層配線部
４ａ・・多層配線領域
５・・・スルーホール
６・・・スルーホール導体

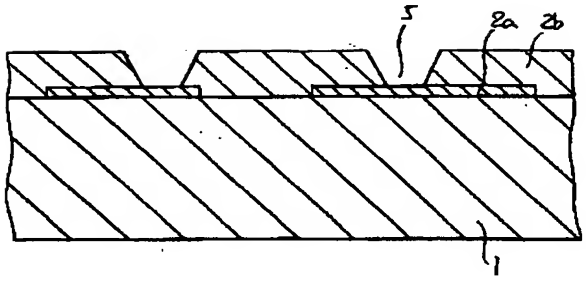
【図２】



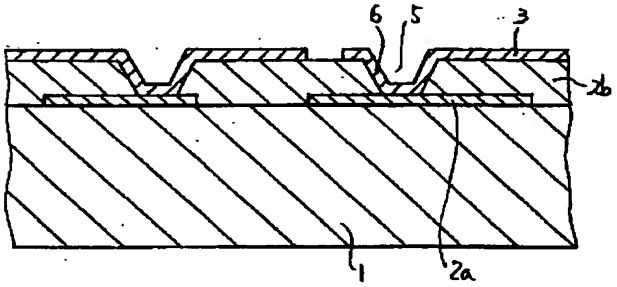
【図１】



【図３】



【図４】



【図５】